
UNIT 5 MANAGEMENT INFORMATION SYSTEMS AND DECISION SUPPORT SYSTEMS

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5.0 OBJECTIVES

After reading this unit, you will be able to :

- understand the concepts of Management Information System (MIS) and Decision Support System (DSS);
- know the structure and design of MIS and DSS; and
- learn the objectives and utilities of MIS and DSS.

5.1 INTRODUCTION

Modern management techniques are highly information oriented. Management is the art of directing human activities for productivity. It directs the active operation within the enterprise and combines the work of employees with the available infrastructure equipment and material for the accomplishment of the centre's common goals. In other words, management is the sum total of three different steps involved in it, i.e., (i) Formulation of policy and its translation into plans, (ii) Execution and implementation of plans, and (iii) Exercising administrative control over the plans. Management is thus the executive function, which is concerned with carrying out broad policies laid down by authorities. Management is also used as a way of referring to the process of managing — the process of planning, organising, staffing, guiding, supervising and controlling. It comprises the process or activities that describe

what managers do in the operation of their organization — Plan, organise, initiate and control operations.

The information explosion over the past years has had a profound impact upon the complexity of management and organization. As a decision-maker, the manager is essentially a processor of information. Modern management looks for the ability to obtain, store, process, retrieve and display right information for the right decision, which is vital. In order to remain ahead of competitors and to keep pace with technological advancements and their impact on the firms' products or services, the manager must keep himself abreast of selected information and organise it for decision-making. MIS is a system that aids management in performing its job. The management process can be described as: planning, directing, organizing, controlling and feedback.

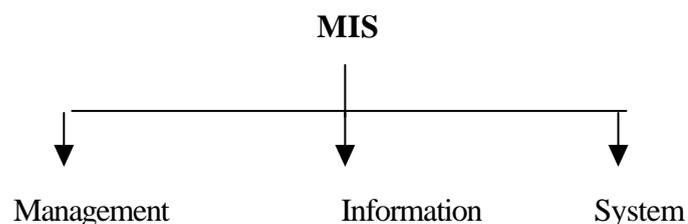
Making decisions concerning complex systems (e.g. management of organizational operations, industrial processes, the command and control of military combat units, management of resource sharing networks) often strains our cognitive capabilities. The decision support system supports the decision-making process in a semi-structured and unstructured environment.

5.2 MANAGEMENT INFORMATION SYSTEM : CONCEPT AND DEFINITION

A Management Information System (MIS in short) is an organized procedure that provides past, present, and prediction information. It plays now-a-days an important and decisive role in planning and decision making by furnishing uniform and timely information. Modern management information systems are computer based systems with built in automatic data retrieval, data capture, selection, sorting, data processing data analysis and data exchange capabilities. MIS is a system which provides management with the information it requires to monitor progress, measure performance, detect trends, evaluate alternatives, make decisions and to take corrective action.

MIS is, thus, a system in which required data are collected and transmitted to help the managers at various levels in the process of planning, implementation and evaluation. In other words, MIS is a system which collects, analyses, stores and displays information to the decision-makers at all levels for the management of resources, flows of material, personnel, money facilities and machines.

It can be concluded that MIS is a computer-based organizational information system which provides information for management activities and functions. The concept of MIS is better understood if each part of the term is defined .



Management

As already explained in the introduction it comprises the processes or activities that describes what managers or executives do in the operation of their organization: plan, organize, initiate and control operations. They plan by setting strategies and goals and selecting the best course of action to achieve the plan. They organize the tasks necessary for the operational plan, set these tasks up into homogeneous groups and assign authority delegation. They control the performance of the work by setting performance standards and avoid deviations from standards. As decision-making is such a fundamental prerequisite to each of the foregoing processes, the job of the MIS becomes that of facilitating decisions (structured decisions) necessary for planning, organizing and controlling the work and functioning of the organization.

Information

Information consists of data that have been acquired, processed or otherwise used for inference purposes, argument, or as a basis for forecasting or decision-making. Information can be facts or figures, qualitative or quantitative, which are essential for arriving at decisions.

System

A system is a set of interrelated elements linked together for a common objective. There is a functional relationship between the different components or parts. The system concept of MIS is therefore one of optimising the output of the organization by connecting the operating system through the medium of information exchange. We are concerned with 3 systems: (1) Organization, (2) The system of management, (3) Management information system, that provides information for making decisions regarding the integration of the organization through the process of management. The computer system is an important component of the MIS system.

The objective of an MIS is to provide information for decision-making on planning, initiating, organizing and controlling the operations of the sub-system of the firm and to provide a synergistic organization in the process. MIS supports decision-making at all levels of the organization.

5.3 NEED OF MIS

The process of management in any organization (be an industry, govt. organization, business, public enterprise) has become very complex now-a-days. The reasons for complexity can be attributed to four primary aspects: (i) the technological revolution, (ii) research and development, (iii) product changes, and (iv) the information explosion. The technological revolution has influenced every sector of economic and social activity like transportation, communication, agriculture, manufacturing, and product techniques. The changes will continue at an accelerated pace. This demands considerable improvement in management. It is imperative that in order to cope with these changes, the manager will require large amount of selective information for the complex task and decisions ahead. Thus, the technological revolution requires a managerial revolution. Increase in expenditure on research and development has greatly accelerated technological changes. This has not only made the product and supporting operations more complex but the life cycle of the product is being shortened. The effect of research and development is tremendous

on their operations and the system should therefore provide for better planning, better management and better information to accommodate the effects.

Particularly in the context to product changes, today's manager must deal with an enormously high product mortality rate. The competition for any product today (may be a car, a television set, a washing machine etc.) is so much that every manufacturing organization is always at the tip of iceberg' which calls for better management and the system approach. This implies that today's manager must keep himself abreast of the factors influencing his other firm's products and future operations. This requirement demonstrates the need for a properly designed management information system.

Finally the information explosion has profound impact upon the complexity of management and organizations. The information is available in a variety of sources and forms which should be made available to the managers at appropriate time This necessitates the creation and development of management information system for better decisions.

Above all there is an increase in the complexity of management, which calls for improvement in the management process. The reasons for the complexity of management are: (1) the theory of information feedback system, (2) a better understanding of the decision-making process, (3) operations research or management science techniques that permit an experimental or simulation approach to complex problems, (4) computers.

5.4 STRUCTURES, DESIGN AND DEVELOPMENT OF MIS

The basic element or ingredient of MIS are concerned with three areas as strategic planning, management control and operational control distributions in the hierarchy of management levels of decision making. MIS has the following elements:

Input (data)

Analysis and Processing

Storage and Retrieval

Output

Flow

Both the input and output are directly related to the information requirements of the organization. The information includes both the inflow of the input as well as the output of the information. The information processing, analysis and storage can be manual, mechanical or electronic. The following steps are necessary for the development of MIS:

- i) Analysis and determination of systems requirements
- ii) Design of MIS
- iii) Procurement of necessary material
- iv) Installation
- v) Operation and follow up.

All these five steps are interrelated. The system is improved through the interaction of these steps :

5.4.1 Analysis and Determinants of Systems Requirements

The analysis of the information needs of the organization as part of the systems requirement is essential to find answer to questions like:

- What are the objectives of the organization
- What are the activities to be carried out
- What type of evaluation is required to assess the impact of its activities
- Who will collect the data
- Where, how and by whom will the data be processed
- How accurate and reliable should such data be
- What will be the frequency and timeliness of the report
- Who will use the information generated and how it will be used.

5.4.2 Design of MIS

The next step is the actual design of information system covering all the five elements mentioned above, in such a manner that it is carried with minimum cost and delay in the required form of the information requirement of the administration. The following points may be kept in mind:

- a) The data generated at various levels should correspond to what is actually needed for management at that level.
- b) The necessary links between the various sub-systems of the MIS should be provided.
- c) An appropriate method for the processing and analysis of basic data should be designed.

5.4.3 MIS Planning

The planning of MIS starts with its scope. There is need for system planning to offset uncertainty, to improve economy of operations, to focus on objectives, and to provide a device for control of operations. MIS objectives are derived from the organization objectives. An overview of the MIS development process is as under:

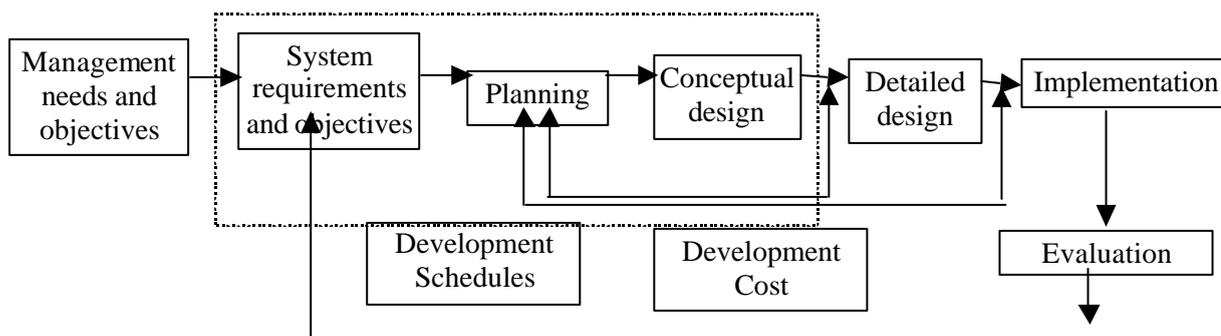


Fig.1: MIS Development

Despite the organization's understanding of the nature and objectives in its operating activities, it is frequently quite difficult to state objectives for systems that cut across all functional areas. The manager must define system objectives in terms of legitimacy of information need and not in terms of satisfaction of demand that are not related to the objective. System objectives must ultimately be stated in terms of the objectives of the department group function or manager to be served or in terms of the function that the information system is to perform. In other words, system objectives should be expressed in term of what manager can do after the information needs have been met. A clear statement of information needs is fundamental and necessary to good system design. Before the step of determining information need it is necessary to consider the information sources which may be categorised as follows–

- i) Internal and external records
- ii) Interviewing managers and operating personnel is a valuable method of identifying possible sources of information and analyzing the existing records.

General Systems Flow

The general system flow chart is a common method of indicating the general structure of a computer-based information system. Shown in such a chart is the description of the data processing logic in general terms. The system flow also reflects the design effects that have gone on before this step, i.e., setting objectives, establishing constraints and determining information needs and sources.

System Inputs

From the user's point of view, the inputs are structured when information source are determined. However, there remains the task of design of input format. Because inputs frequently have to be accepted in the form in which they are received from outside the organization, input design becomes a matter of converting these to machine-usable form. More detailed input data specification includes the sources of data, i.e., where they come from, in what form they are and who is responsible for their production.

System Outputs

From the technical standpoint, the output data definition includes the specification of definition (i.e., where they go, what form they take, and who is responsible for receiving them). Included in the specifications are the distribution of output (who gets what, how many copies and by what means), the frequency with which output will be called for and its timing and the form the output will take.

The conceptual design report is in a sense, a proposal for the expenditure of funds and for organization changes.

Software, Hardware and Tools

The software design should actually start at the time of conceptual design. The trained programmer should develop standards and procedure for programming. Standard charting symbols, techniques and records should be maintained. He should develop the data processing logic and prepare the programming flow charts. The hardware requirements should also be considered.

The MIS for an industrial manufacturing organization should have the following components/divisions

Management Information System

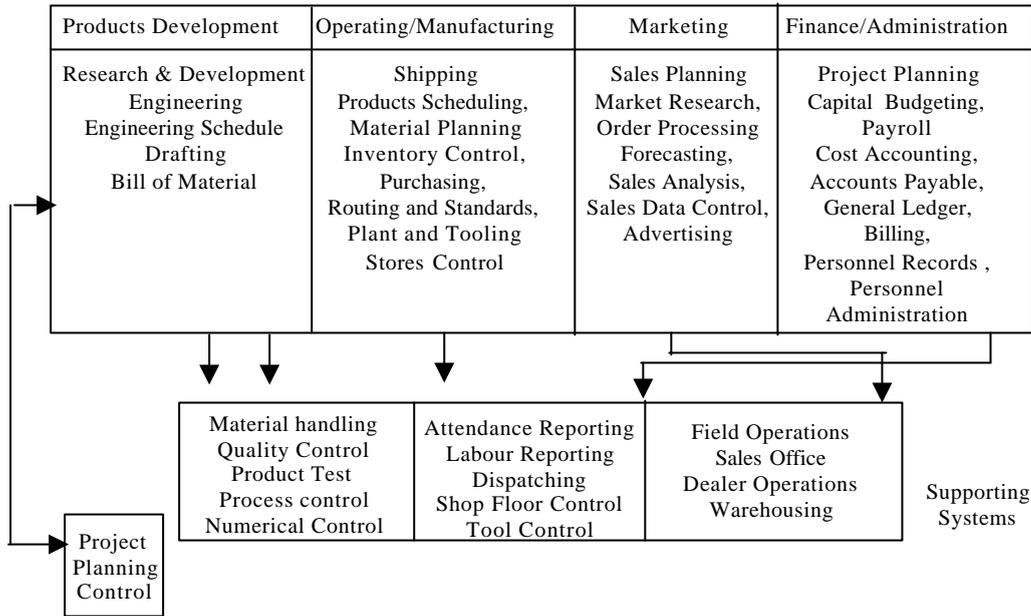
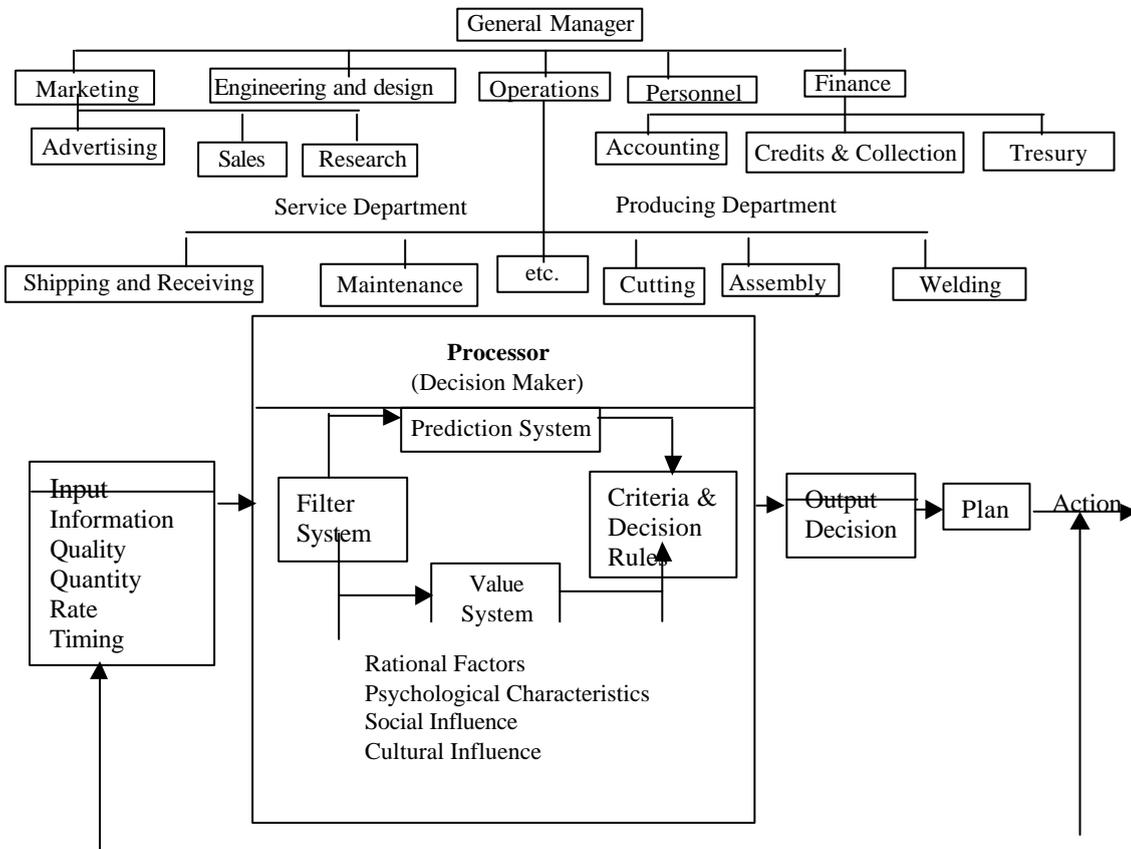


Fig. 2: MIS Development

**Basic Information System
Organizational Structure**



Management and the Decision System

Fig. 3: Organizational Structure

5.5 IMPLEMENTATION, EVALUATION AND MAINTENANCE OF MIS

The design of an MIS may seem to be an expensive project to management, the cost of setting the MIS on time satisfactorily may often be comparable to that of its design. There are three basic phases for implementing MIS once the design has been completed. These are initial installation, the test of the system as a whole; and the evaluation, maintenance and control of the system. The major implementation tasks usually consist of:

- Planning the implementation activities.
- Acquiring and laying out facilities and offices
- Developing procedures for installation & testing
- Developing the training programmes for operating personnel
- Completing systems software
- Acquiring required hardware
- Generating files
- Designing forms
- Testing of entire system
- Documenting the system
- Evaluating the MIS

The MIS is specifically developed for routine operations. In the detailed design phase, the specification for the files are developed. In the implementation stage, the actual data must be obtained and recorded for the initial testing and operation of the system. This requires a check list of data, format of data storage form and format and remarks to indicate when the data have been stored. In the detailed design phase, each item of data for the files is specified and the retrieval methods (index) are developed. In the implementation stage, forms must be designed so that the data may be analysed by the programmer who decides codes for storage in the computer. The development of files or databases belongs to the conceptual realm of information systems designs, storage and retrieval experts.

After the MIS has been operating smoothly for a short period of time, an evaluation of each step in the designs and the final system performance should be made. The feedback principle should apply to the work of the MIS as well as to the product. Evaluation can be done from the cost benefit point of view also by comparing the old and the new systems.

Maintenance is closely related to control. Maintenance is that ongoing activity that keeps the MIS at the highest levels of effectiveness and efficiency within cost constraints. In other words maintenance of MIS is directed towards reducing errors due to design, due to environmental changes and improving the systems scope and services. These activities are sometimes classified as: (1) emergency maintenance, (2) routine maintenance, (3) system maintenance which may apply to the following activities :

- Changes in policy statements
- Changes in reports received by a manager who replaces an outgoing manager
- Changes in forms
- Changes in operating systems
- Changes in procedure
- Changes in hardware or hardware configuration
- Software modification or addition
- System controls and security needs
- Changes in inputs from the environment,

Specific responsibility for maintenance should be assigned to a supervisor and team of MIS analysts, programmers and forms specialists.

5.6 DECISION SUPPORT SYSTEMS: CONCEPT AND DEFINITION

The Decision Support System (DSS) is a relatively recent development in the field of information systems, representing a radical departure in the application of computers and information to the decision-making processes in the organization. Instead of providing periodic reports or answers to ongoing problems as is done in management information systems, the DSS emphasises the support to the decision making process of the manager. The support entails the use of a computerized information system by the individual to explore, analyze and examine the alternative choices for the solution of problems of a non-routine nature. The system enhances the cognitive capabilities and serves as a stimulus that improves the decision-making process.

The concept represented by DSS is different from that of MIS. The DSS aims to support the decision-maker in a complex problem-solving environment which represents a radical departure in the application of computer and information to the decision-making process in the organization. The origin of the system is considered to have began in the early 1970's with contribution from Scott Morton, who developed the management decision systems in 1971. The support provided by the DSS entails the use of a computer system to access facts or data and to provide filtering and pattern recognition ability to the data retrieved, as well as generate computation facility to the data for comparison and projection. Decision support systems are gaining increased popularity in various domains including business, engineering, military, medicine and information service. They are especially valuable in situations in which the amount of available information is prohibitive for the intuition of an unaided human decision-maker and in which precision and optimality are of importance. DSS can aid human cognitive deficiencies by integrating various sources of information, promoting intelligent access to relevant knowledge, and aiding the process of structuring decisions.

DSS differs fundamentally from MIS in that the former is always oriented to the particular kind of decision that is categorised as unstructured (ill structured). A DSS is designed and developed to support managers in structuring the unstructured decision

problems, in building a model of the problem, and in specifying criteria and sets of alternatives before making a final choice.

The decision involves three things: (i) creation of a concept of a desired state of affairs, (ii) apparent state of actual conditions, (iii) generation of kind of action to be taken in accordance with the discrepancy between the derived and actual states. The process of conversion of information into the proposed action is decision-making. Due to limited cognitive ability to select and categorise data for processing, decision-makers typically use a few broad categories of data even when such broad categorization suppresses important information. They attempt to reduce the input (data) from the environment to a manageable quantity by selecting and filtering. A DSS serves as a back up to the cognitive process and provides pattern recognition ability to the data retrieved. DSS provides support in the form of graphics summaries of reports or time series analysis, which helps the decision-maker to categorise all rich information in order to find relevant data that sharpens or refines the understanding of the problem and that reduces dispersion in the various probability distributions. Thus DSS incorporates a database, a database management system, a modeling facility as well as dialogue generation and management software. DSS as a field is interdisciplinary in nature drawing upon work from database management, language processing, OR and modeling, AI, formal logic, cognitive psychology and other disciplines.

Framework of DSS

DSS is based on the model of HIPS proposed by Newell and Simon : It explains how the human mind processes information. It comprises the following components.

- Perceptual sub-system – comprising receptors and buffer memories
- Cognitive processor
- Internal memory – comprising short-term memory (STM), long-term memory (LTM)
- Motor sub-system

Definition of DSS

Michael S. Scott Morton has defined DSS as an interactive computer-based system that helps decision-makers utilize data and models to solve unstructured problems.

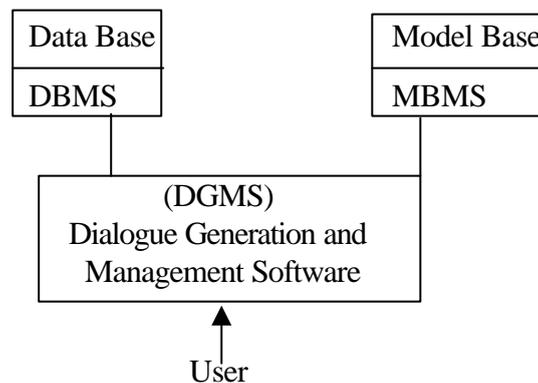
Gorry & Scott Morton defined DSS as a system to support managerial decision-makers in semi-structured and unstructured decision situations. Little has characterized DSS as a model-based set of procedures, data and judgment to assist the manager in his decision-making tasks.

Bonczek characterized DSS as a computer-based interactive system consisting of three components. These three components are: (i) Language system to provide communication between user and other components of the system, (ii) a knowledge system, (iii) a problem processing system. Keen has viewed DSS as a tool for providing access to information and analytic models directly to decision-makers in order to support decision tasks that blend the use of both intuitive judgment and analytical methods.

Structure of a Decision Support System

DSS is an interactive computer based-system that aid users in judgement and choice activities. It provides data storage and retrieval but also enhances traditional information access and retrieval function with support for model building and model-based reasoning. It supports framing, modeling and problem solving. There are three fundamental components of the Decision Support System :

- i) Database and database management: A DBMS serves as a databank for DSS. It stores large quantities of data that are relevant to the class of problems for which the DSS has been designed. A DBMS separates the users from the physical aspects of the database structure and processing.
- ii) Model Base and Model Base Management: The function of MBMS is analogous to that of DBMS. The purpose of MBMS is to transform data from the DBMS into information that is useful in decision-making.
- iii) Dialogue Generation and Management System (DGMS): It is a software for managing interface between the user and the system.



Structure of DSS

Data Base and Data Base Management System

Data represent certain parts of the real or conceptual problem domain, in other words problem space in symbolic form. A database is a collection of data stored in a computer to be used for analysis and interpretation of the problem being investigated. The database must have a defined structure. Data for DSS has internal as well as external source.

The database should have certain important capabilities like : Data reduction, support for memories, varying levels of detail, varying amount of data, multiple sources wider time frame, varying degree of accuracy, random access, performance and user interface. The databases are a collection of data structures, which includes lists, tables, relations, hierarchies and networks. A DSS may use one or more of the following types of data model: record model, relational model, hierarchical model, network model and rule model. The selection of a data model is based on operation and integrity constraints. Data stored in the database are normally structured and formulated into fields, records and files. A data model is described as a set of objects. These objects can be either values or relationships among values. Record model is the oldest and most common data model with the most varied data structures and

the well defined operations and integrity constraints. It is a set of records each consisting of a set of fields. In the relational model, the data structure of the relational model is united. It provides a mathematical basis for set operation on record and defined integrity constraints. The data structure in the relational model consists only of relations. In a hierarchical model there may be several descendant record types at any level, and for any record there may be several instances of descendant. A network model consists of sets of records and links, but the links are explicit. The rule model is seldom used in the traditional information systems but it is common in expert system or intelligent system where the model is called production rule.

Modeling and Model Management System

The modeling component is an important feature of a DSS which provides the decision maker with the capability to describe and analyse existing problems as well as to generate and compare alternative solutions. The modeling facility of a DSS improves the cognitive capabilities of Data Modeling(DM). Human beings approach problem solution tasks by developing appropriate mental models of the problem to work on. The modeling facility of DSS enables a decision-maker to replicate the mental model of the phenomenon under study. An important aspect of the modeling components of a DSS from the decision-making point of view is that it allows feedback and provides interaction between the user and the system, permitting the user to examine clues that may help in identifying problems and in inventing, developing and analysing the possible courses of action. The main activities of the modeling components are : projection, deduction, analysis, creation of alternatives, comparison of alternatives, optimization and simulation. The modeling component helps the user in drawing an inference and exercising control. The model base contains a library of models. The model base management system perform the functions: Generation, Restructuring updating, and Report generation enquiry.

Dialogue Generation and Management System

The dialogue sub-system is an extremely valuable component of the DSS, which provides capabilities to the user to interface with database and permits the use of the system in an interactive and iterative mode. The DSS draws its characteristics of user friendliness and flexibility from the dialogue system. A dialogue system includes the user, the terminal and software component. The dialogue system is divided into three parts : The action language, presentation language and knowledge base. There are different dialogue styles used in DSS as follows :

- i) Question-answer dialogue
- ii) Command language
- iii) Menu dialogue
- iv) Input-output form dialogue
- v) Input in context of output dialogue

Systems Requirement

A DSS requires a set of modeling capabilities in order to meet the following functional needs:

- A model base and a set of software functions to manage it
- Integration of the modeling component with the dialogue component

— Integration of the modeling component with the data component.

Self Check Exercise

- 1) What is management information systems (MIS) ?
- 2) What are the structural elements of the MIS ?
- 3) What is decision support system ?
- 4) What are the structural components of DSS ?

Note: i) Write your answers in the space given below.
 ii) Check your answer with the answers given at the end of this unit.

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5.7 SUMMARY

A Management Information System (MIS) is generally thought of as an integrated user machine system providing information to support operations, management and decision making functions in an organization. The MIS is more suited for supporting decisions which are of a structured nature, i.e., the tasks are of routine and repetitive nature. The semi-structured tasks are hard to routinise. Thus MIS are inadequate to support the decision-making process of semi-structured and unstructured tasks because the solution involves some judgement and subjective analysis.

The decision-making process can be split into three phases:

- 1) **Intelligence** - Which means searching the environment for conditions calling for decision. At this stage raw data are collected, processed and analyzed for clues that may help to identify the problem.
- 2) **Designing** - Involves the process of inventing, developing and analysing possible course of action. In this phase an attempt is made to understand the problems to generate potential solutions and to test them for reasonableness.
- 3) **Choice** - The third phase choice involves selecting a course of action from those available. This also includes implementation after the choice is made.

A DSS permits the users to interface with the collected information with a model, through a modeling facility of the computer to generate some predictions, beliefs or expectations. DSS supports decision-makers in semi-structured and unstructured decision situations.

5.8 ANSWERS TO SELF CHECK EXERCISES

1) Management Information System is a information system that aids management in making, carrying out and controlling decisions. Thus MIS is a system that aids management in performing its job. It provides management with information, it requires to monitor progress, measure performance, detect trends, evaluate alternatives make decisions and take corrective actions. It is a computer-based information system which provides information to support management activities and functions. It is a combination of information storage and retrieval systems. The goal of MIS is to supply managers or executives with the information that would help them to plan and control operations. Thus management information system is an organised method of providing past, present, and projection information relating to internal operations and external intelligence. It supports the planning, control and operational functions of an organization by furnishing information in the proper time frame to assist the decision-making process.

2) The structural elements of MIS are :

Input (data)

Analysis and Processing

Storage and Retrieval

Output

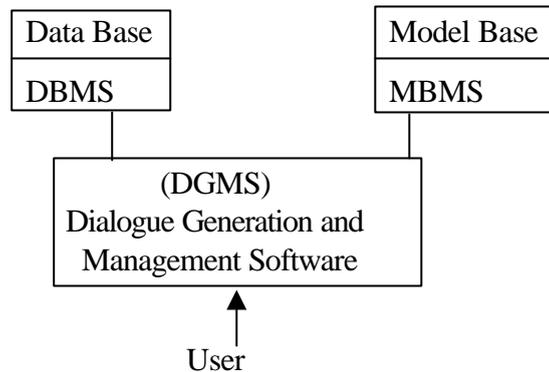
Flow

Both the input and output are directly related to the information requirements of the organization. The analysis and processing component are an important aspect of MIS. The input information is analysed, evaluated and processed from the viewpoint of management requirements. The information after processing is stored using a specific database management software which provides the facility for the retrieval of information in a desired format and structure. In order to develop MIS, there is a need to understand the management structure of the organization itself. The work breakdown structure has to be worked out and the information needs of each specific work of management has to be determined. The analysis process is a level-by-level breakdown from system to sub-system, sub-system to task, task to subtask and subtask to work package. The flow of information within the organization (may be in the form of report etc.) has to be worked out.

3) The Decision Support System (DSS) is an information system that allows the decision maker to combine his or her judgement with computer output in a human machine interface for producing meaningful information to support the decision- making process. The system aids in solving all types of problems (semi-structured and unstructured). Thus DSS is a computer based interactive system consisting of three interacting system components: (a) language system (b) a knowledge system and (c) a problem processing system. The DSS supports the decision-making process, by helping the decision-maker to utilize data and models to solve unstructured problems.

4) Decision support systems are interactive computer-based systems that aid users in judgement and choice activities. They support framing, modeling and problem-solving. There are three fundamental components of the decision support system:

- i) Database and database management system
- ii) Model base and model base management system
- iii) Dialogue generation and management system



The database is a collection of data stored in a computer to be used for analysis and interpretation of the problem being investigated. The database must have a defined structure. The DSS may use different types of data model to store data that are relevant to the problem for which DSS has been defined.

The model base is the modeling component of the DSS which provides the DM with the capability to describe and analyse existing problems as well as generate and compare alternative solutions whereas the Dialogue Generation and Management System manages the interaction between the user and the system with the help of dialogue language.

5.9 KEYWORDS

- Databases** : It is a collection of logically interrelated data stored in a computer with the facility of easy access and retrieval.
- Decision Making** : The process of selecting the most desirable or optimum alternative to resolve a problem or to attain a goal.
- Decision Support System (DSS)** : An information system to support decision-makers in semi-structured and unstructured decision situations.
- Dialogue Sub-system** : A component of DSS which provides capability to the user to interface with database and permits the use of the system in an interactive and iterative mode.
- Heuristics** : It is an ad hoc mode of decision making or simplification that reduces or limits the search in a large problem space. They are the rules of the thumb and reflect bounded rationality.

- HIPS** : Human Information Processing System is the cognitive system of the human mind which processes information for decision and action.
- Information** : Information is the symbolic element used for communicating knowledge irrespective of the nature (numerical, textual etc.), material carriers, form of presentation, etc. It refers to both substance or content of documents and to physical existence. The term is also used to designate both the message (substance and form) and its communication (act).
- Management** : Is a process and agency which directs and guides the operation of an organization in the realization of established aims.
- Management Information System (MIS)** : A system which provides management with information it requires to monitor progress, measure performance, detect trends, evaluate alternatives, make decision and to take corrective action.
- Model Base** : It is a component of DSS, which provides the decision-maker with the ability to describe and analyse existing problems as well as to generate and compare alternative solutions. It comprised a library of models.
- Structured decision** : The decision tasks which are usually of a routine and repetitive nature and require little analysis or judgment. A definite procedure has been worked out for handling them.
- Unstructured decision** : The decision tasks which are usually of a non-routine and non-repetitive nature. There is no clear cut method for handling the problem because it has not arisen before.

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